Water Management for Peatland Restoration at Pocosin Lakes National Wildlife Refuge

Howard Phillips and Sara Ward
U.S. Fish and Wildlife Service

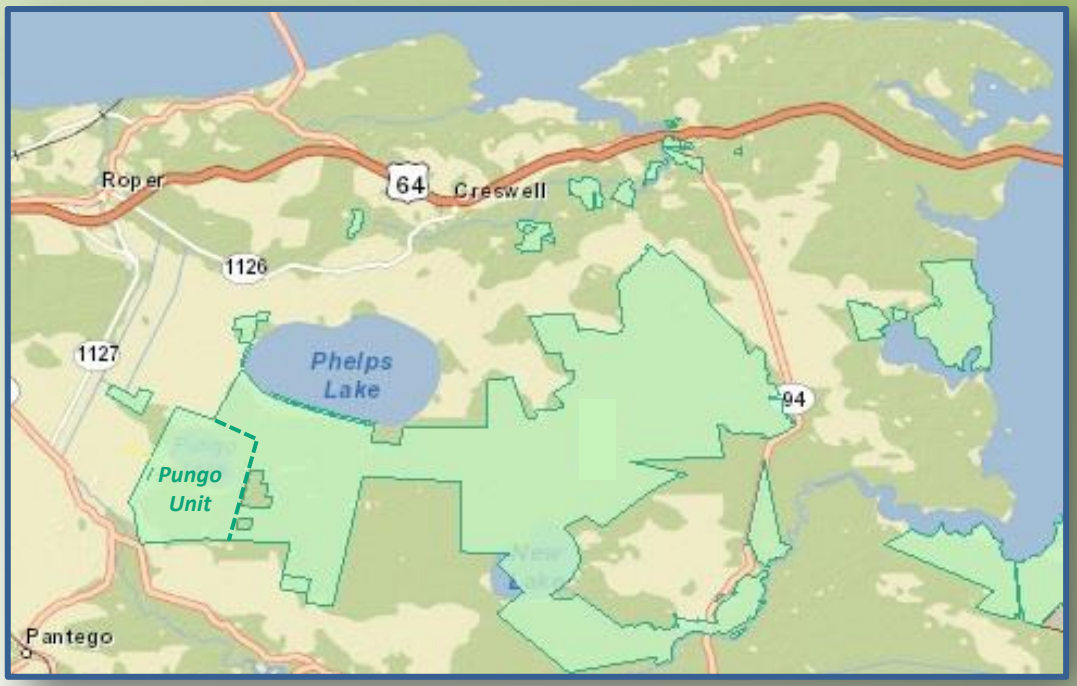
NCGA Agriculture and Forestry Awareness Study Commission Meeting
April 14, 2016

Overview

- Pocosin Lakes – brief history
- How is the restoration achieved?
- Addressing landowner interests
- Why is peatland rewetting so important?
- A natural solution to natural problems
- What's next? Clayton Blocks Restoration

Pocosin Lakes NWR: A Brief History

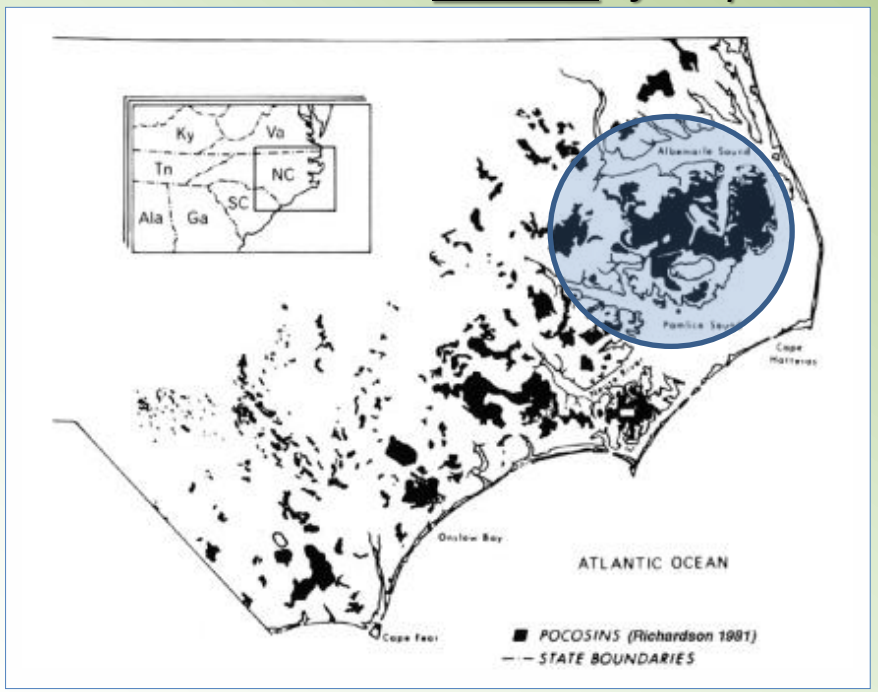
- Pungo NWR established early 1960s - waterfowl
- Pocosin Lakes NWR established early 1990s - pocosin
- USDA hydrology restoration design (1994)
- Last 20+ years: implementation as funding secured
- Restoration, adaptive management, and research on-going



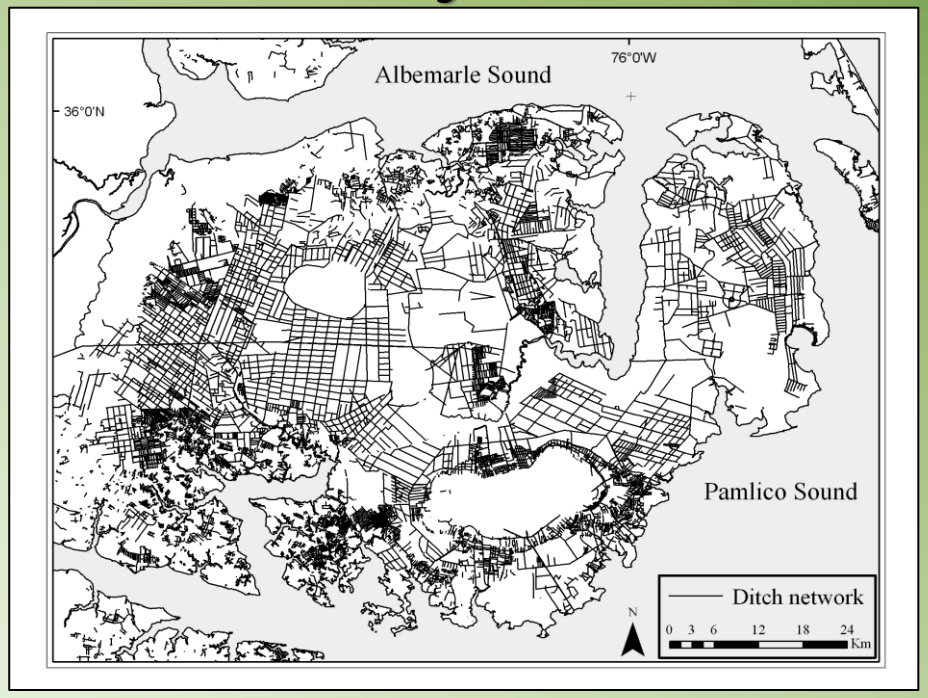
Refuges Focused on Restoring Unique Pocosin Habitats

- Fire-dependent southeastern shrub bogs
- Peat soils act as “sponge”
- Drainage causes rapid peat loss via oxidation and subsidence
- Large-scale stewardship responsibility (habitat, wildfire risk management)

70% loss of NC pocosins since 1962 via ditching



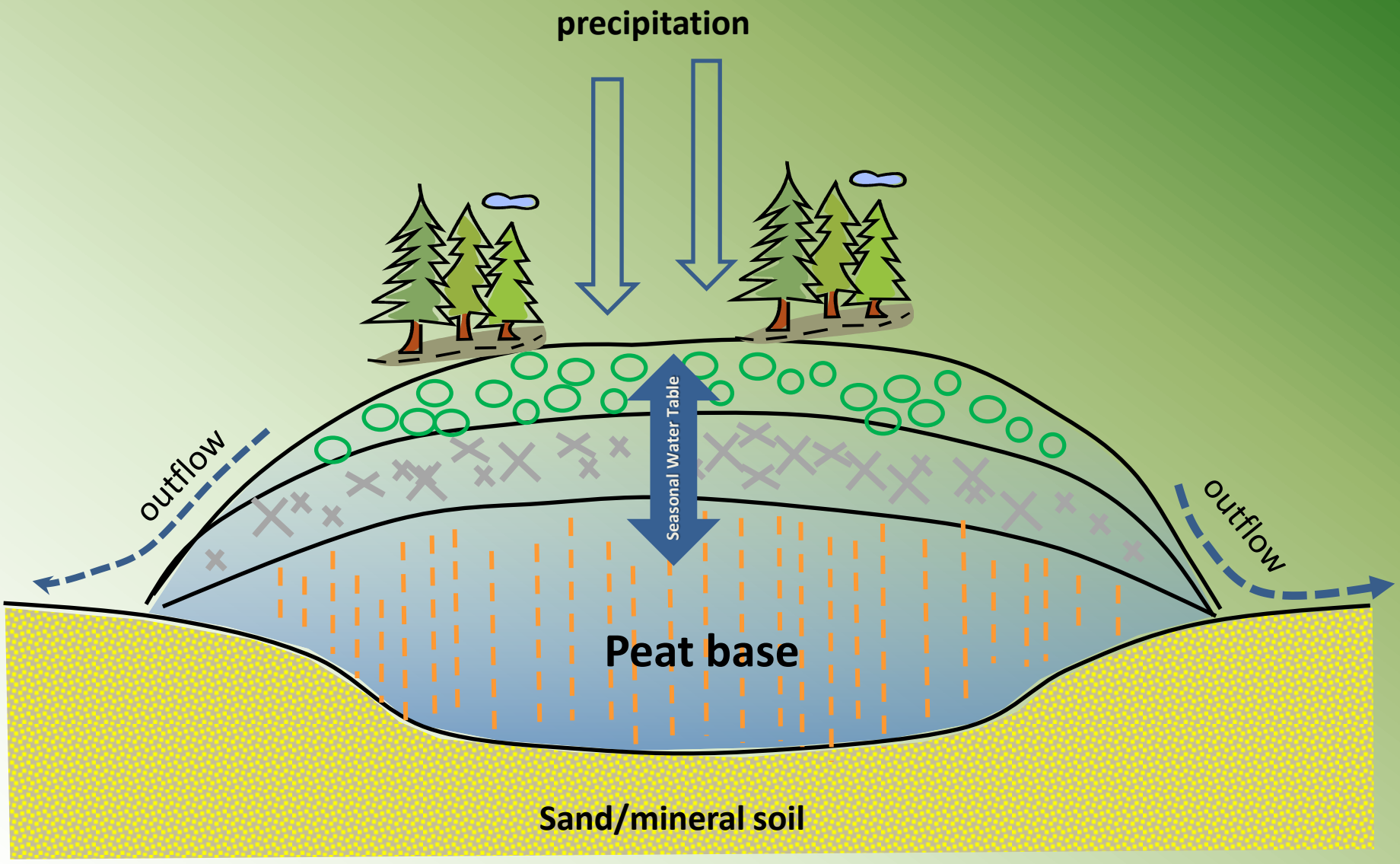
1962 pocosins (Richardson 2003)



Poulter, Duke Univ.

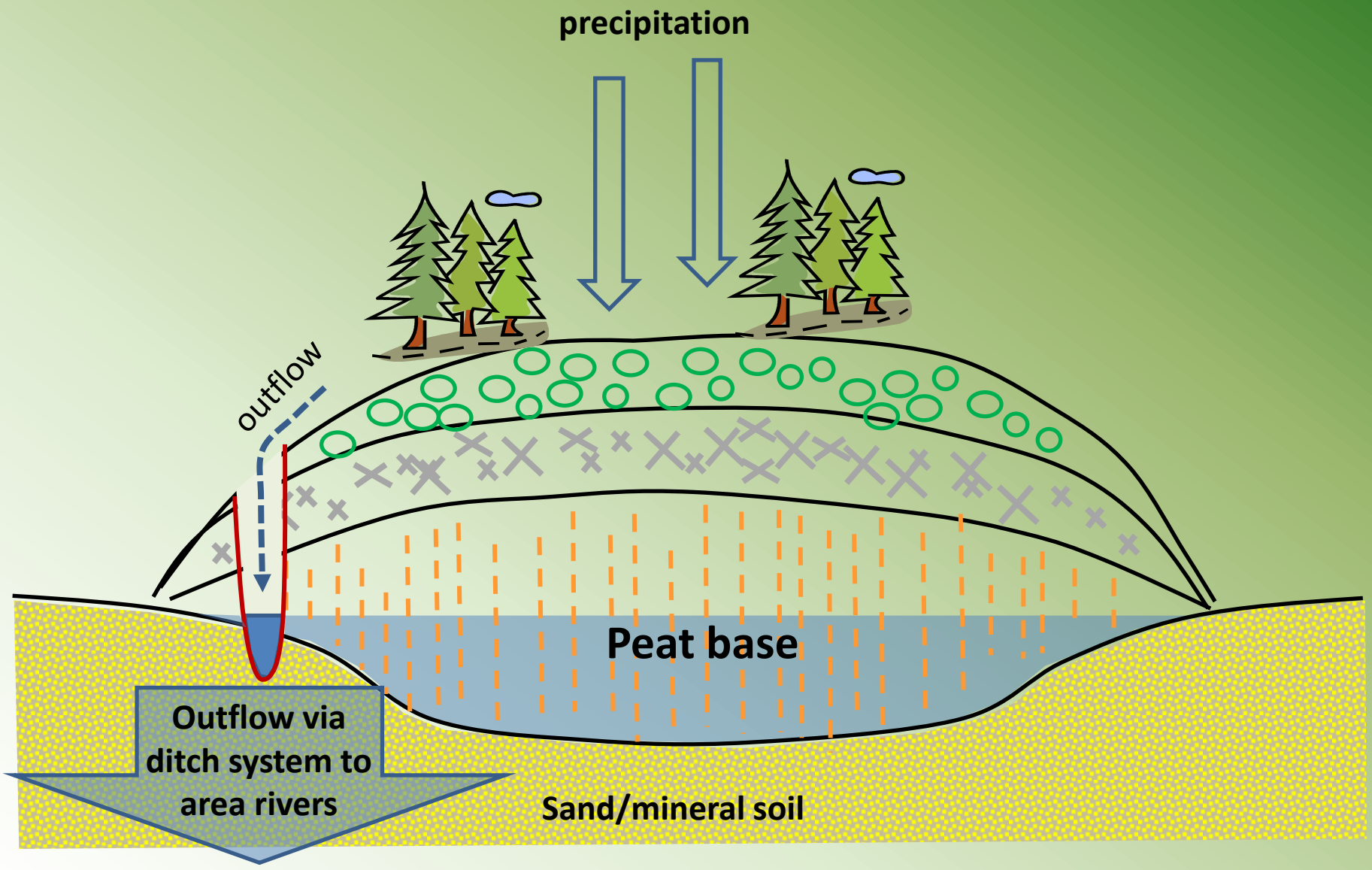
Pocosin: Swamp on a Hill

Pre Alteration: flow over & through the land to river



Pocosin: Swamp on a Hill

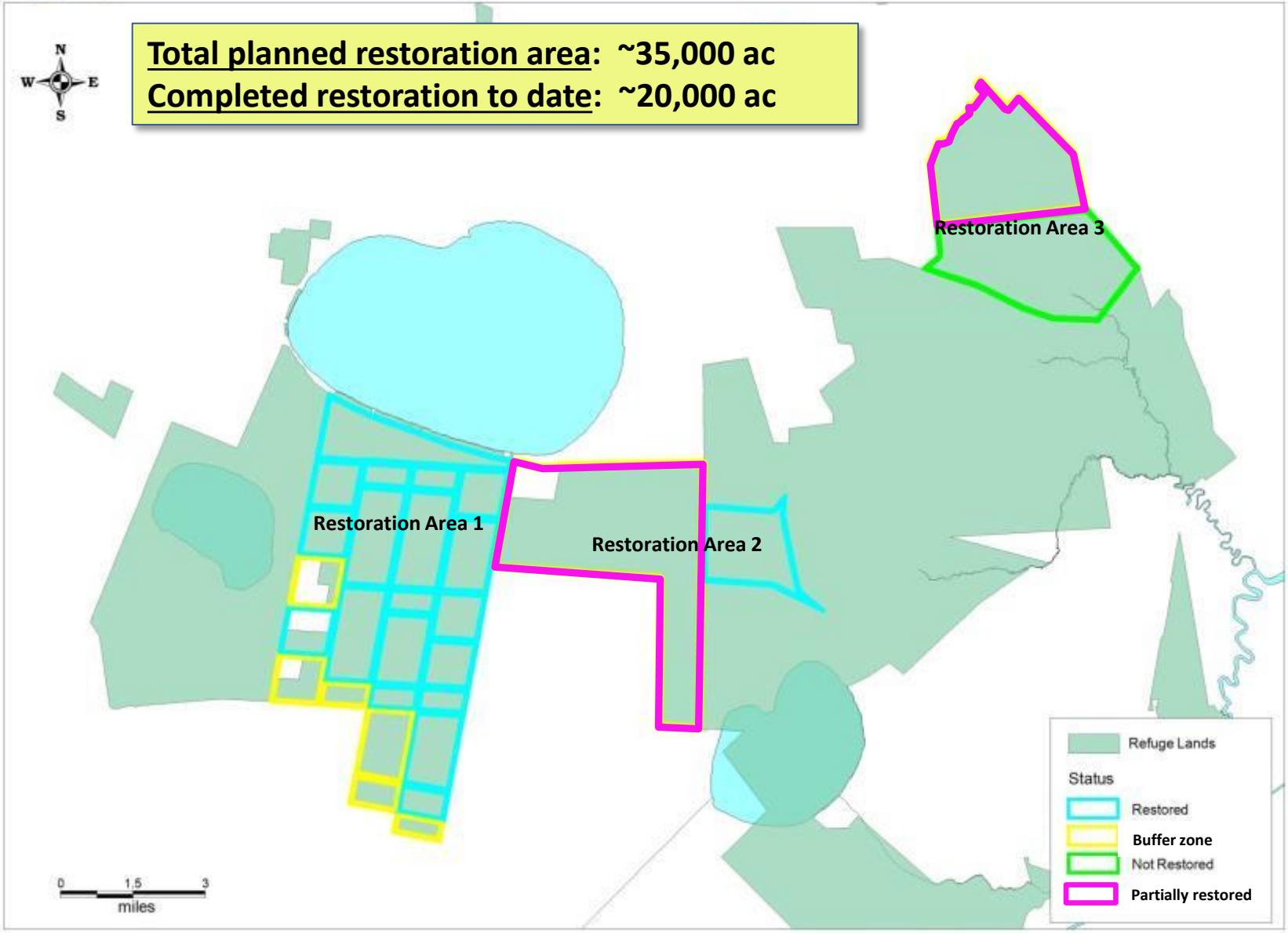
Post Alteration: flow through ditch system to river (to a point)



U.S. Fish & Wildlife Service

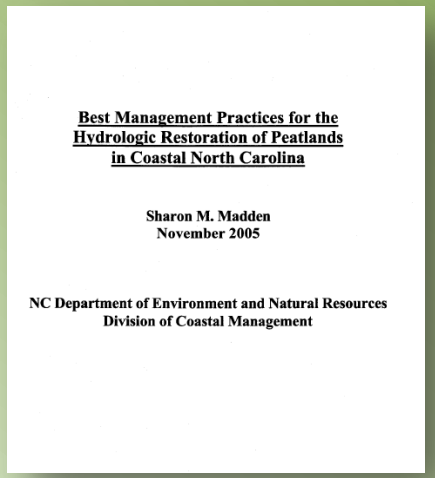
Hydrology Restoration Areas - Pocosin Lakes National Wildlife Refuge

Total planned restoration area: ~35,000 ac
Completed restoration to date: ~20,000 ac



How? Hydrology Restoration Approach

1) Stop artificial drainage
2) Re-wet peat
3) Mimic natural hydrology
4) Science-based adaptive management



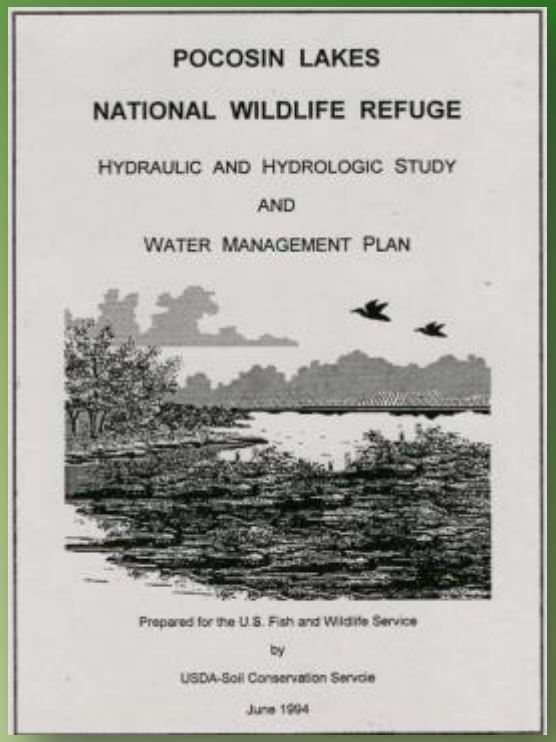
Best Management Practices for the Hydrologic Restoration of Peatlands in Coastal North Carolina

Sharon M. Madden
November 2005

NC Department of Environment and Natural Resources
Division of Coastal Management

The 1994 Study/Design

- Modeling-based alternatives analysis
  - uncontrolled drainage / open ditches
  - controlled drainage / water management



"Flooding on the NWR, and on adjacent off-site landowners, will occur when rainfall amounts exceed the capacity of the drainage system regardless of the management scenario used by NWR managers"

"Controlling drainage should improve water quality, enhance wildlife habitat, restore a semblance of the original pocosin hydrology, reduce the chance of wildfire, and improve drainage conditions on adjacent, downstream farms"

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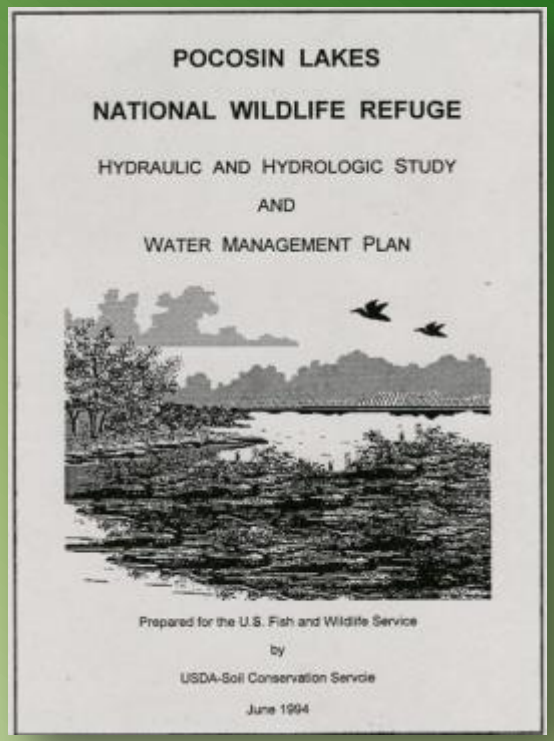

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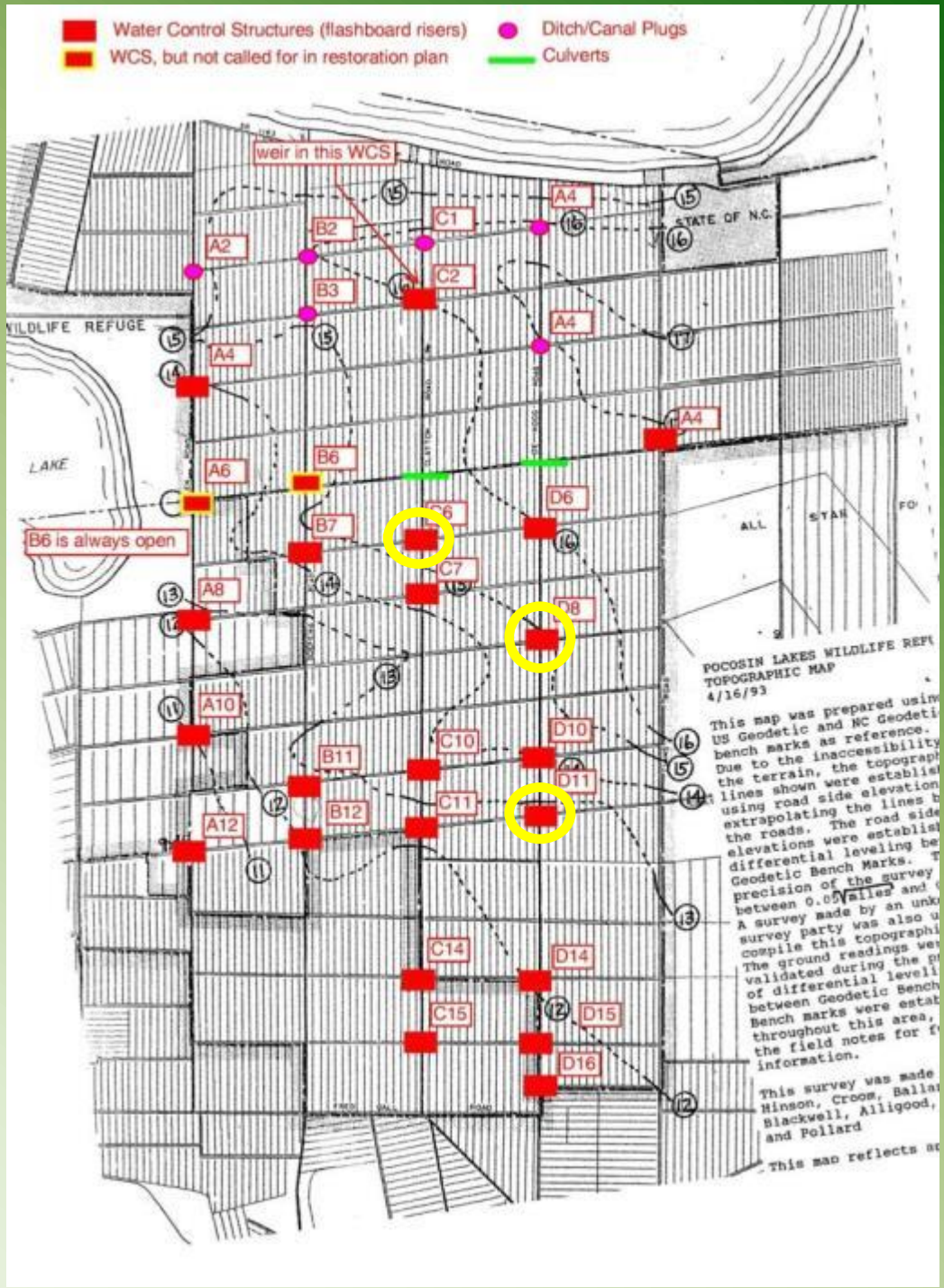
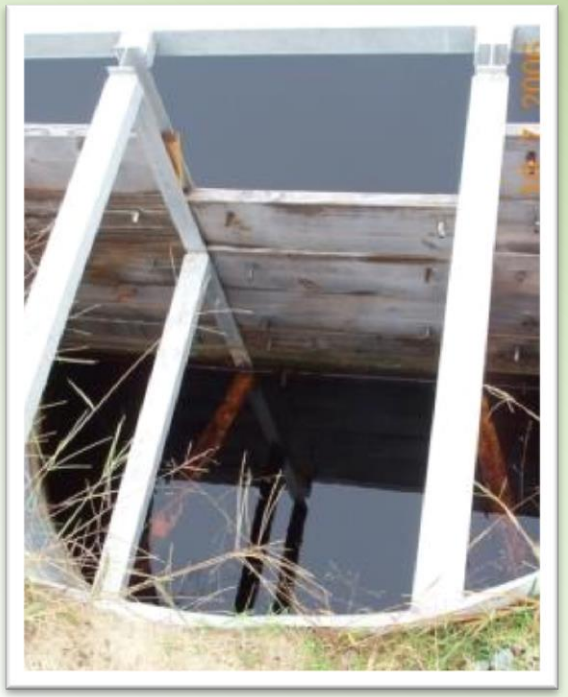
Hydrology Restoration

- Install WCSs based on 1 ft contours





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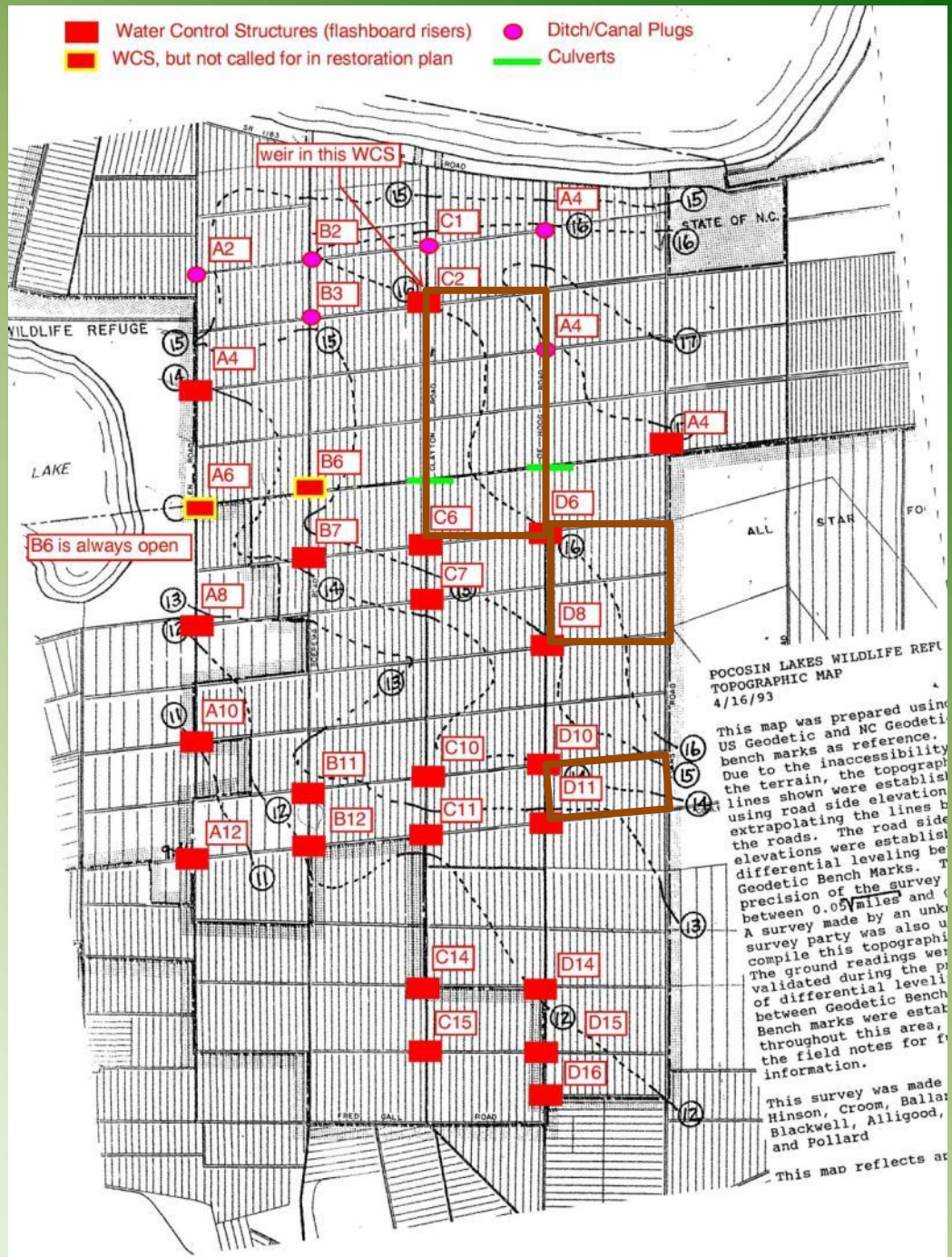
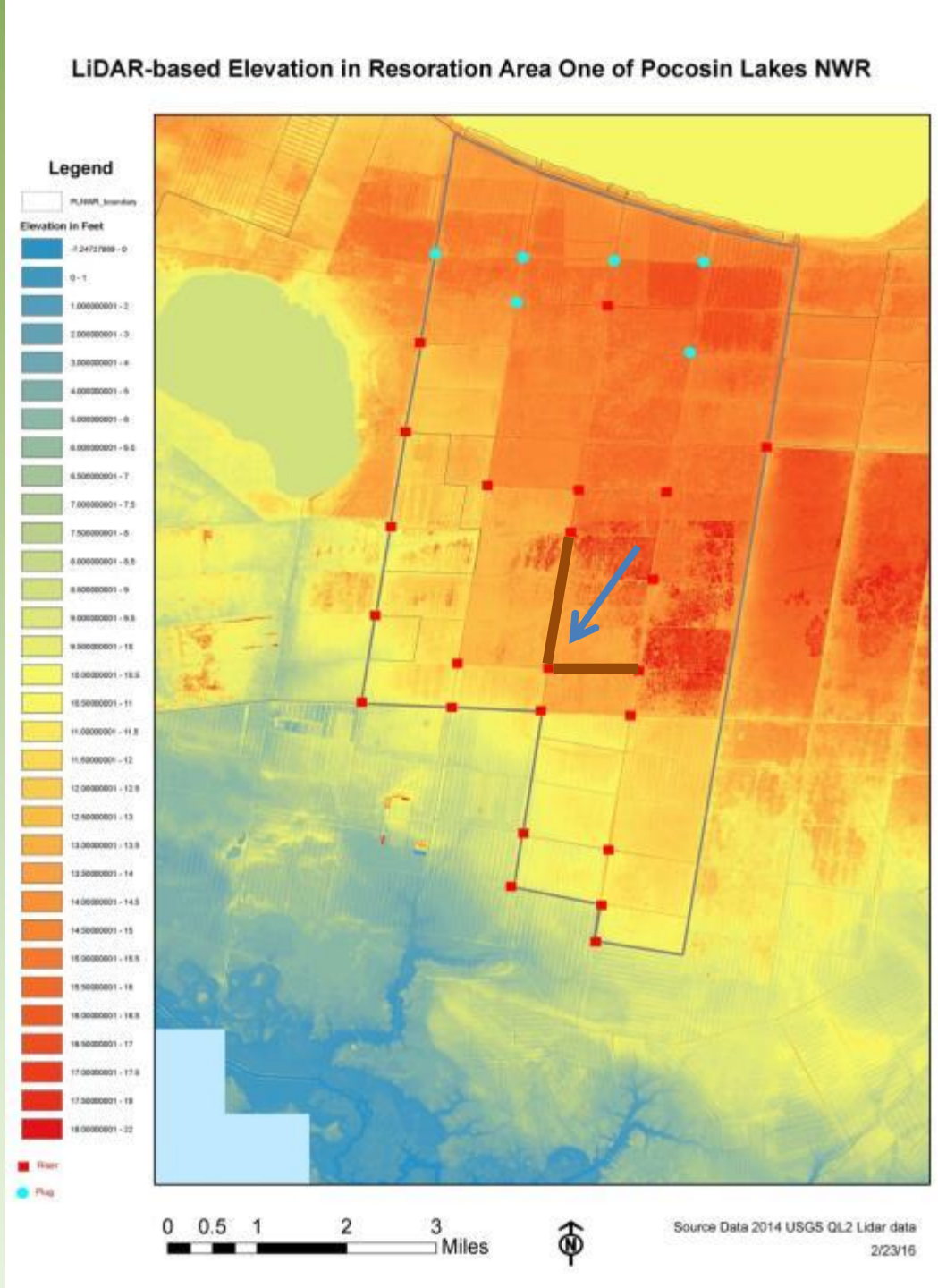


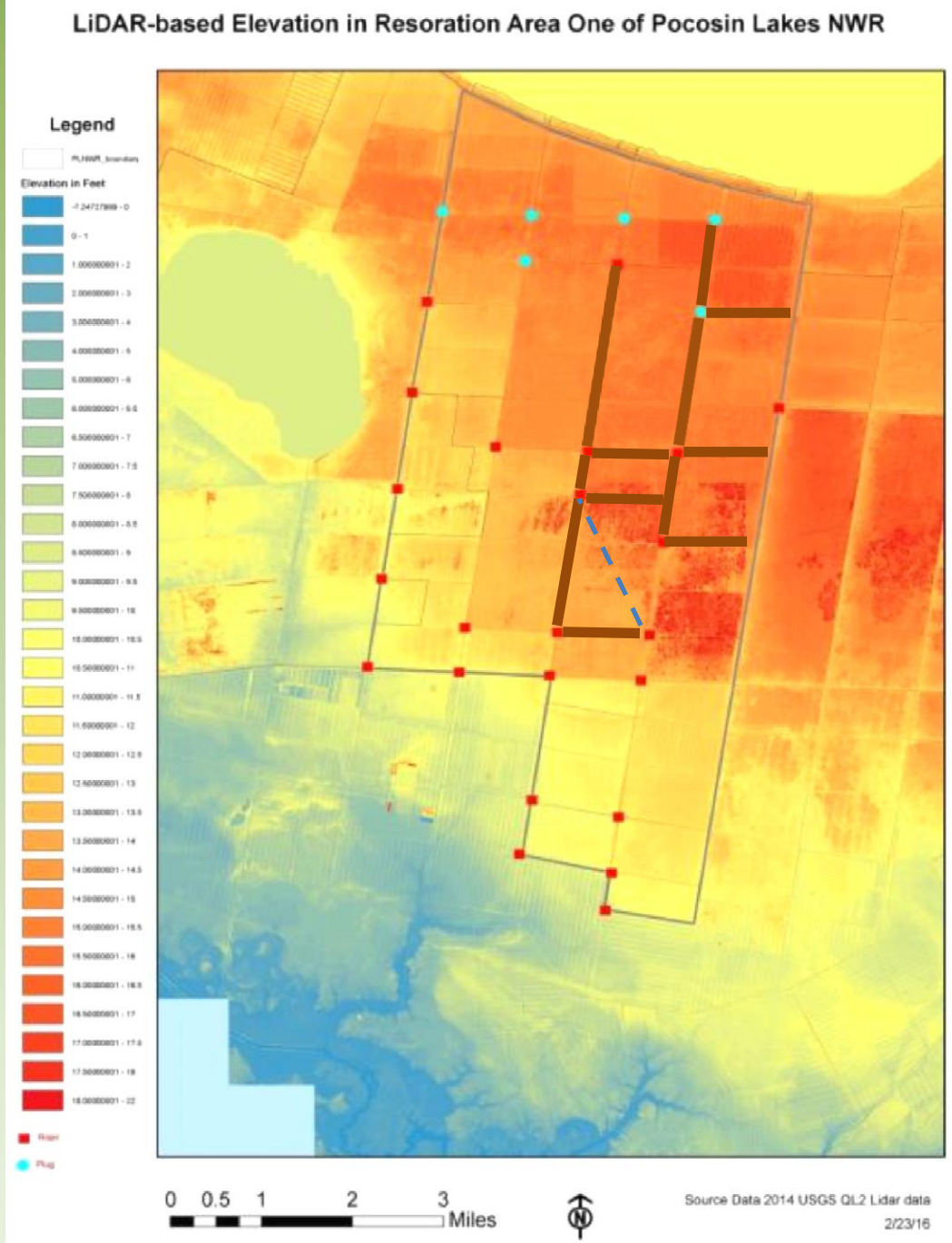
Hydrology Restoration

- Install WCSs along 1 ft contours
- Raise the road (levee) along the down-gradient sides



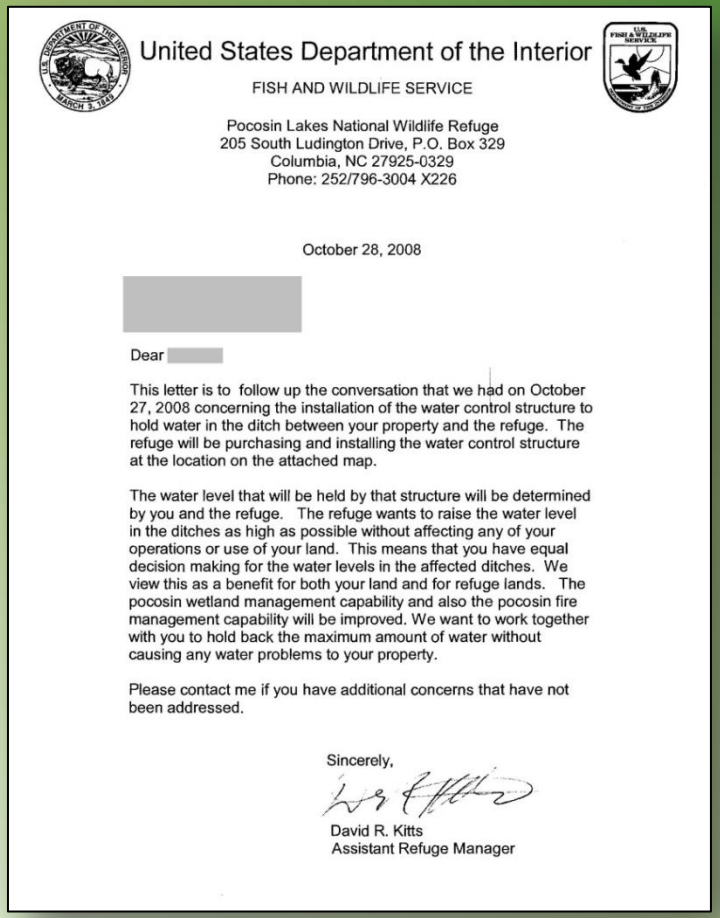
Hydrology Restoration

- Install WCSs along 1 ft contours
- Raise the road (levee) along the down-gradient sides
- Set the boards at a level that corresponds to saturation at mid point along the gradient
  - Stops the artificial drainage of the soil and rewets it
  - Actual water level fluctuates based on rainfall, evapotranspiration, etc.
- Mimic seasonal hydrology of pocosin wetlands
- Stage water up the “hill”



Measures to Avoid Water Impacts on Adjacent Lands

- Cultivate landowner relationships
  - Responsive management
  - Communication with landowners about water management
- USDA Wetland Reserve Program easements to complement restoration
- Buffer zones
- Hydrologic isolation via levee construction



United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pocosin Lakes National Wildlife Refuge
205 South Ludington Drive, P.O. Box 329
Columbia, NC 27925-0329
Phone: 252/796-3004 X226

October 28, 2008

[redacted]

Dear [redacted]

This letter is to follow up the conversation that we had on October 27, 2008 concerning the installation of the water control structure to hold water in the ditch between your property and the refuge. The refuge will be purchasing and installing the water control structure at the location on the attached map.

The water level that will be held by that structure will be determined by you and the refuge. The refuge wants to raise the water level in the ditches as high as possible without affecting any of your operations or use of your land. This means that you have equal decision making for the water levels in the affected ditches. We view this as a benefit for both your land and for refuge lands. The pocosin wetland management capability and also the pocosin fire management capability will be improved. We want to work together with you to hold back the maximum amount of water without causing any water problems to your property.

Please contact me if you have additional concerns that have not been addressed.

Sincerely,

David R. Kitts
Assistant Refuge Manager

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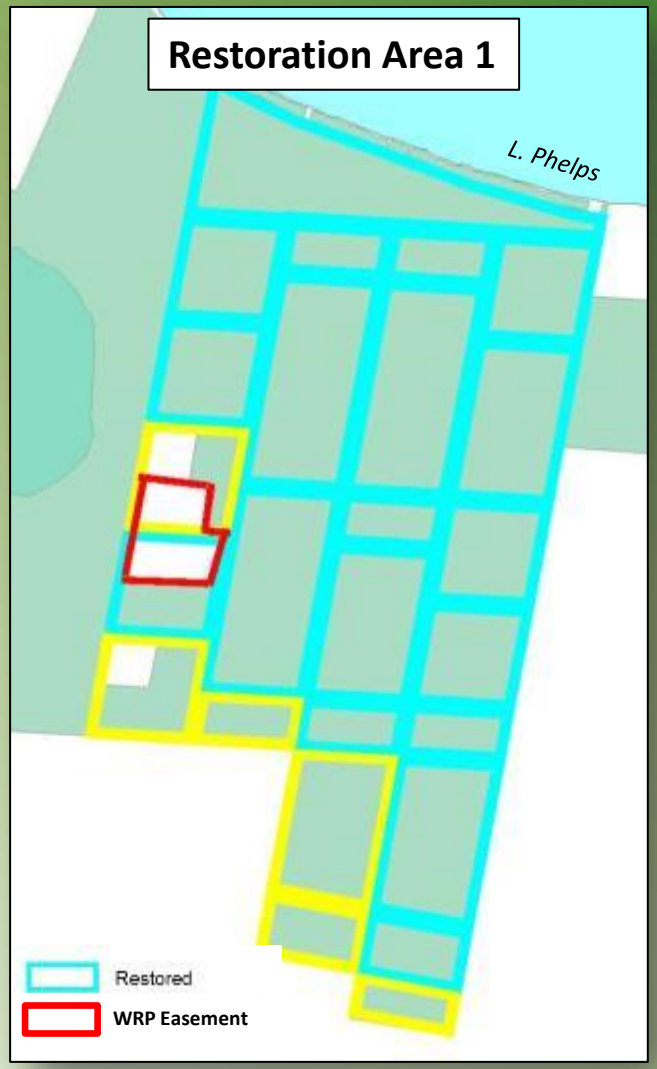

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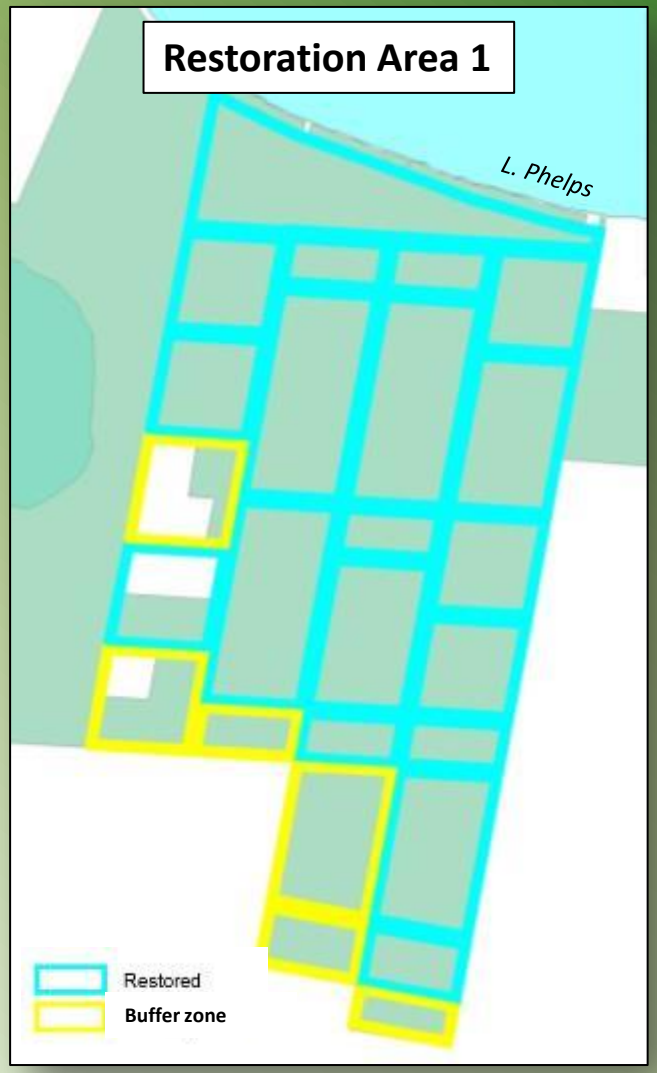

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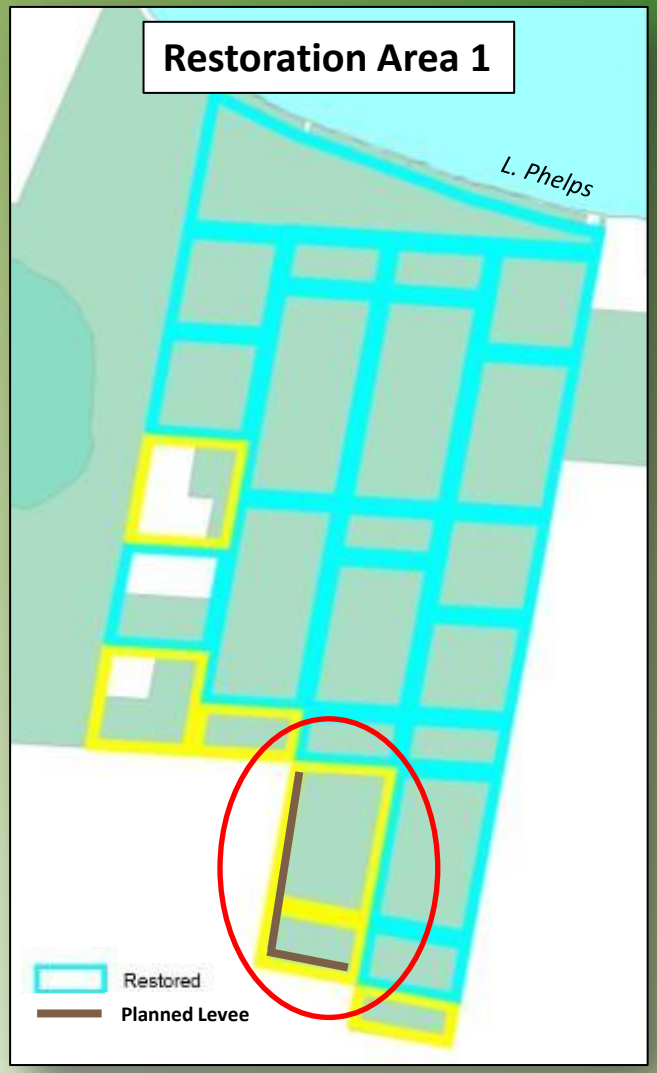
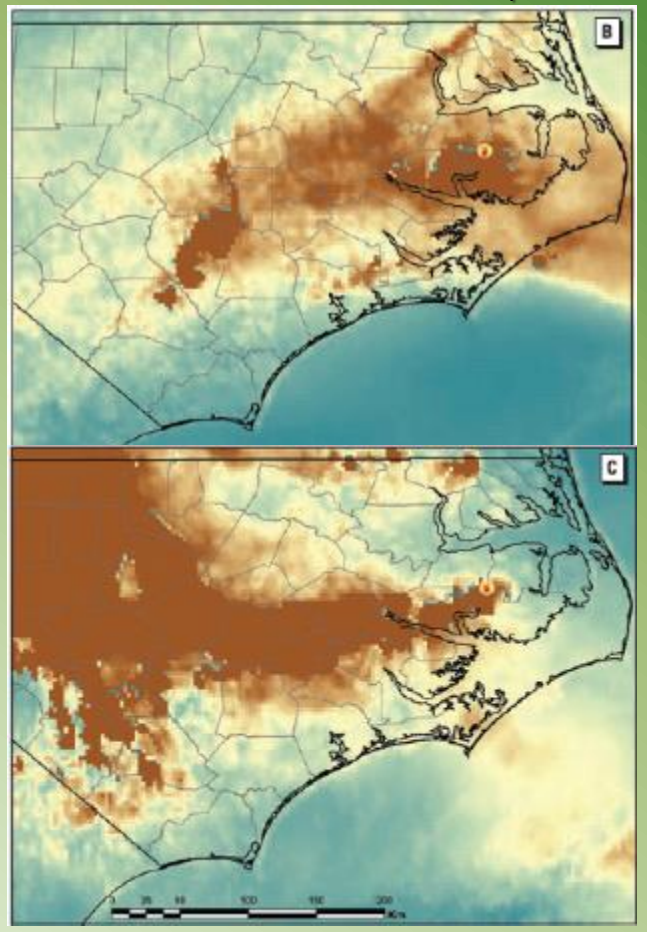


Pocosin restoration is good for wildlife and people

- Enhances wildlife habitat
- Protects estuarine water quality
- Soil conservation
  - Prevents soil loss
  - Restores soil accumulation
- Reduced frequency and intensity of wildfires
- Lessens flooding from storms

Wildfire: Public health and Tourism Implications



2008 Evans Rd Fire affected areas on 6/11 (b) and 6/12 (C).
Rappold et al. *Env. Health Perspect*., 2011

A Natural Solution to Natural Problems

Fire & Rain

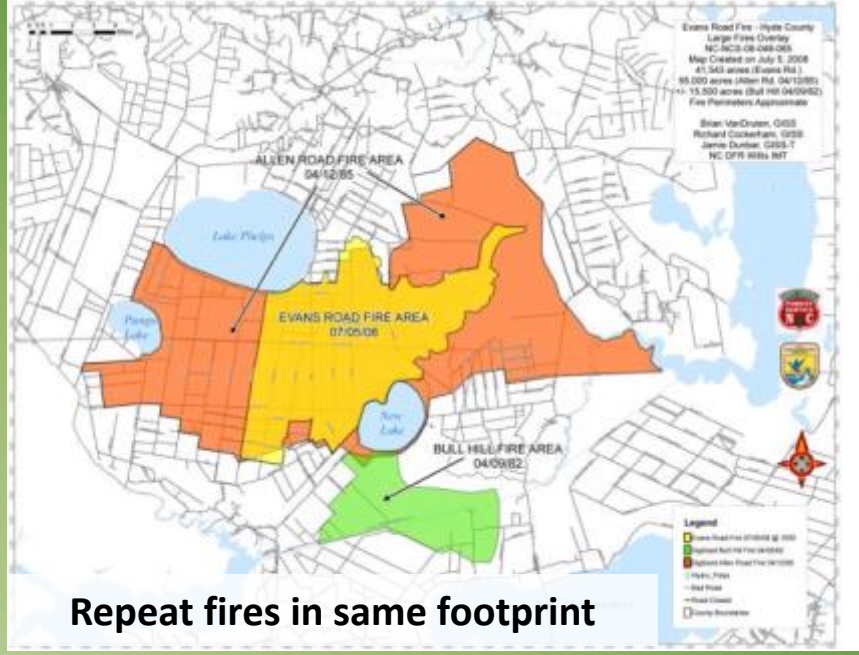
Photos: USFWS unless noted

Restoration addresses fire vulnerability of peat soils

- Raises water table
- Increases soil moisture
- Allows water storage
  - before (prevention)
  - during (suppression)
- Allows for above ground controlled burning under favorable conditions
  - wildlife habitat
  - fuel reduction

2008-2011: 4 catastrophic fires on 3 Refuges

- 94,000 ac burned
- $58M cost; 562 days to put out
- Region-scale smoke (visibility, health)
- > 5 ft soil elevation loss in areas

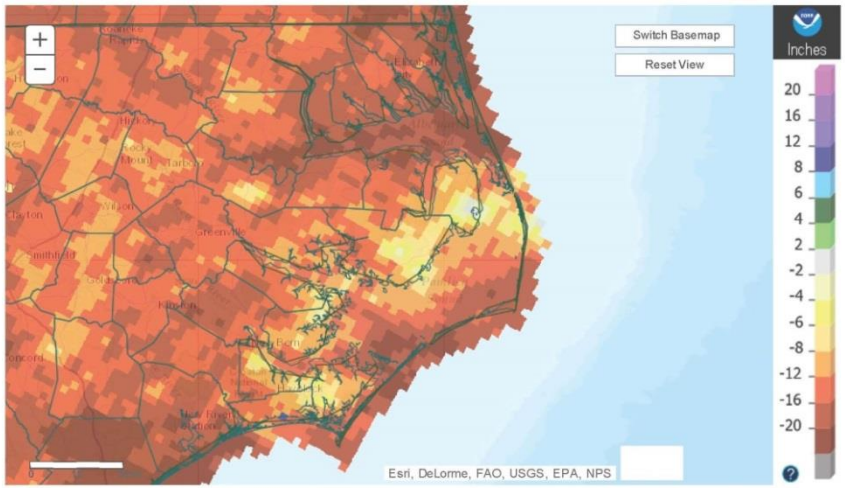


Repeat fires in same footprint

Predicted return interval = 50-150+ yrs; actual return interval recently MUCH shorter.

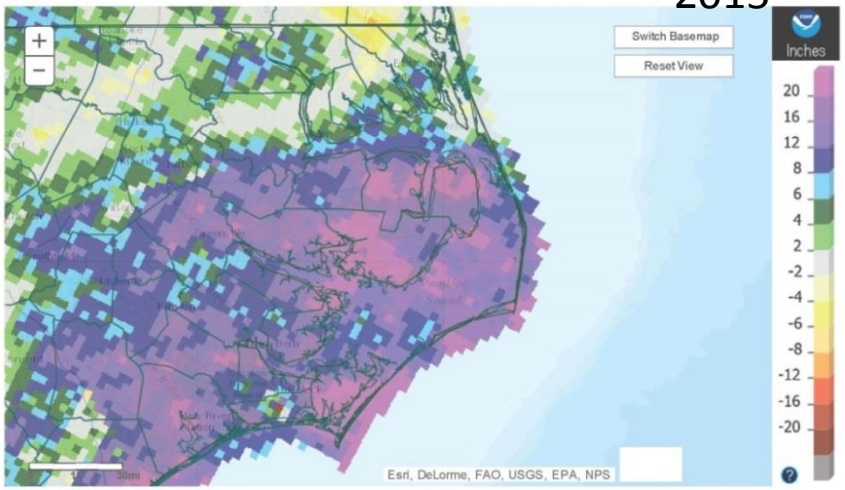
Departure from Normal Rainfall

2007



Wakefield, VA: 2007 Annual Departure from Normal Precipitation
Valid on: January 01, 2008 12:00 UTC
What is UTC time? Map Help

2015

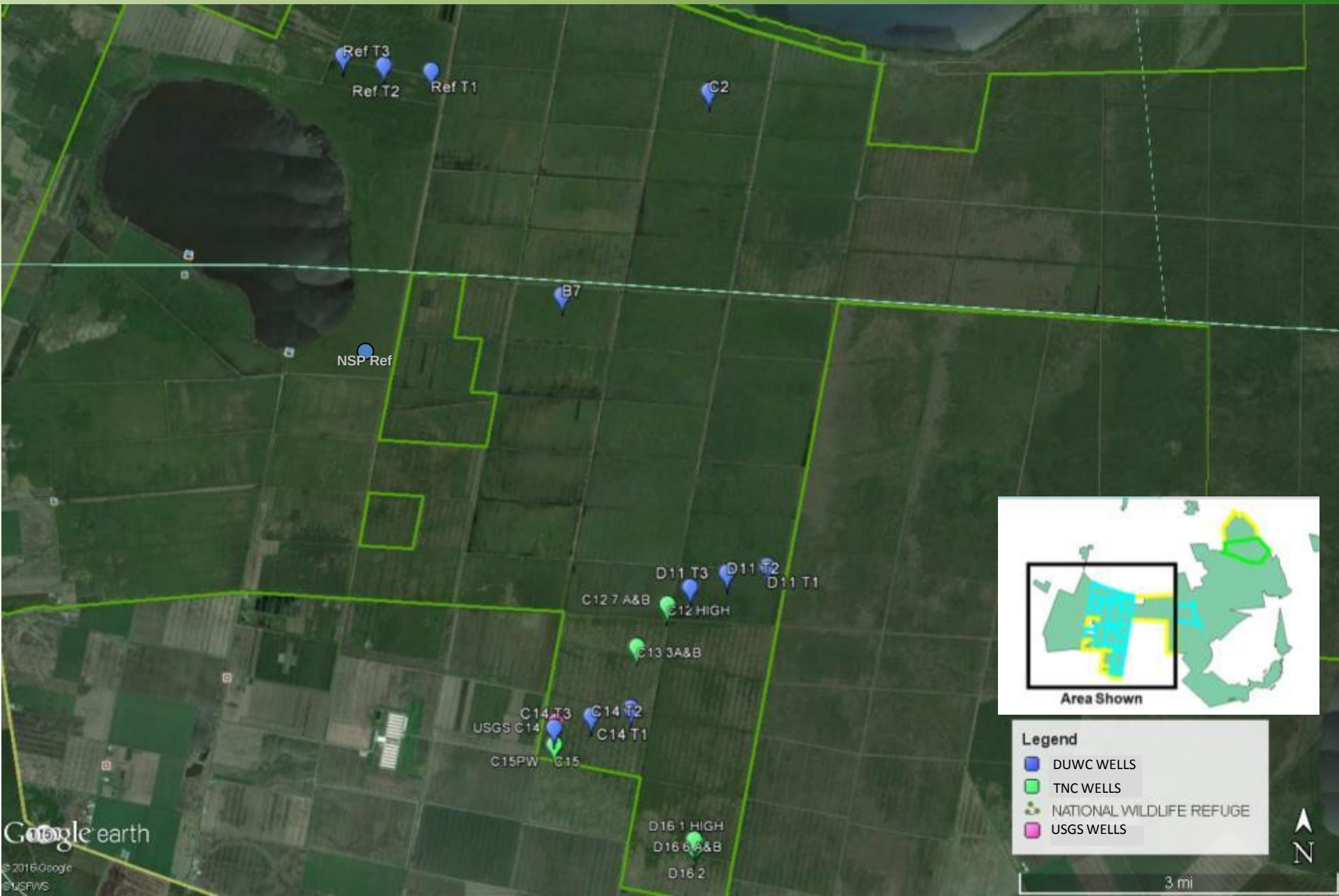


Wakefield, VA: 2015 Annual Departure from Normal Precipitation
Valid on: January 01, 2016 12:00 UTC
What is UTC time? Map Help

Restoration Buffers Extremes

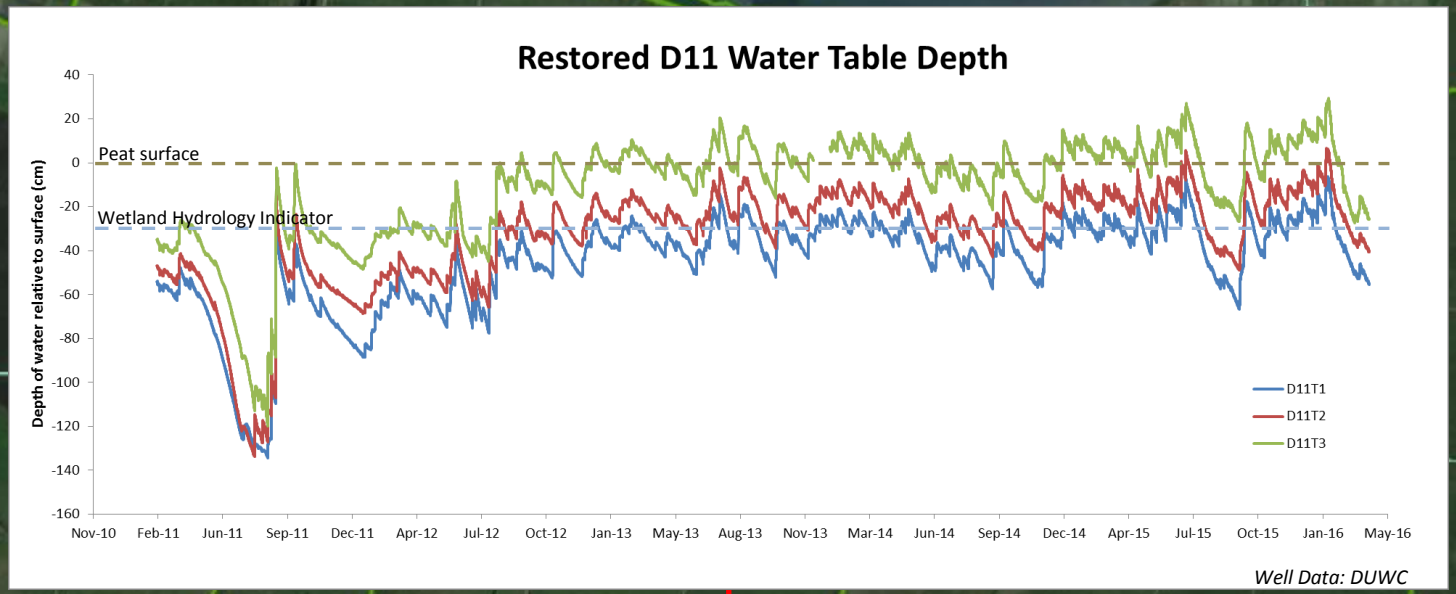
- Flooding naturally occurs in eastern NC
- “Swamp on hill” promotes flow to ditches and rivers
- Controlled drainage mitigates storm-related flooding
  - Reduces runoff rates and volume
  - Some storm water retention benefits realized
  - Limits saltwater intrusion
  - Re-wetting ≠ flooding

Re-wetting ≠ Flooding: Water Level Data



Water Levels: Reference Site

Water Levels: Restored (D11)



Water Levels: Drained (C14)

Drained C14 Water Table Depth

Depth of water relative to surface (cm)

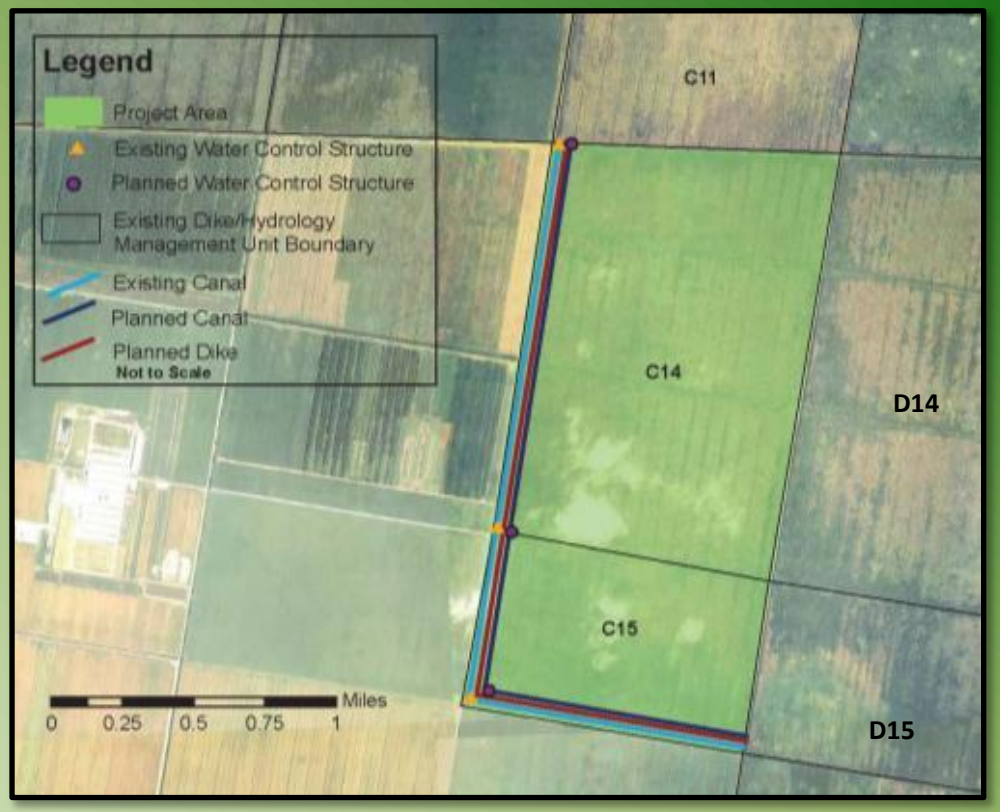
40
20
0 — Peat surface
-20 — Wetland Hydrology Indicator
-40
-60
-80
-100
-120
-140
-160

Nov-10 Jun-11 Dec-11 Jul-12 Jan-13 Aug-13 Mar-14 Sep-14 Apr-15 Oct-15 May-16

C14 T1
C14 T2
C14 T3

Well Data: DUWC

What's Next? Clayton Blocks Project



- Rewet ~1,300 acres
- Monitoring pre- and post-restoration (USGS/TNC)
  - Water levels
  - Soil accretion
- Permits secured in 2015
- New levee to prevent offsite impacts; evaluation by independent hydrologist
- Significant partnership effort / science, experience, and leverage funds:

Questions

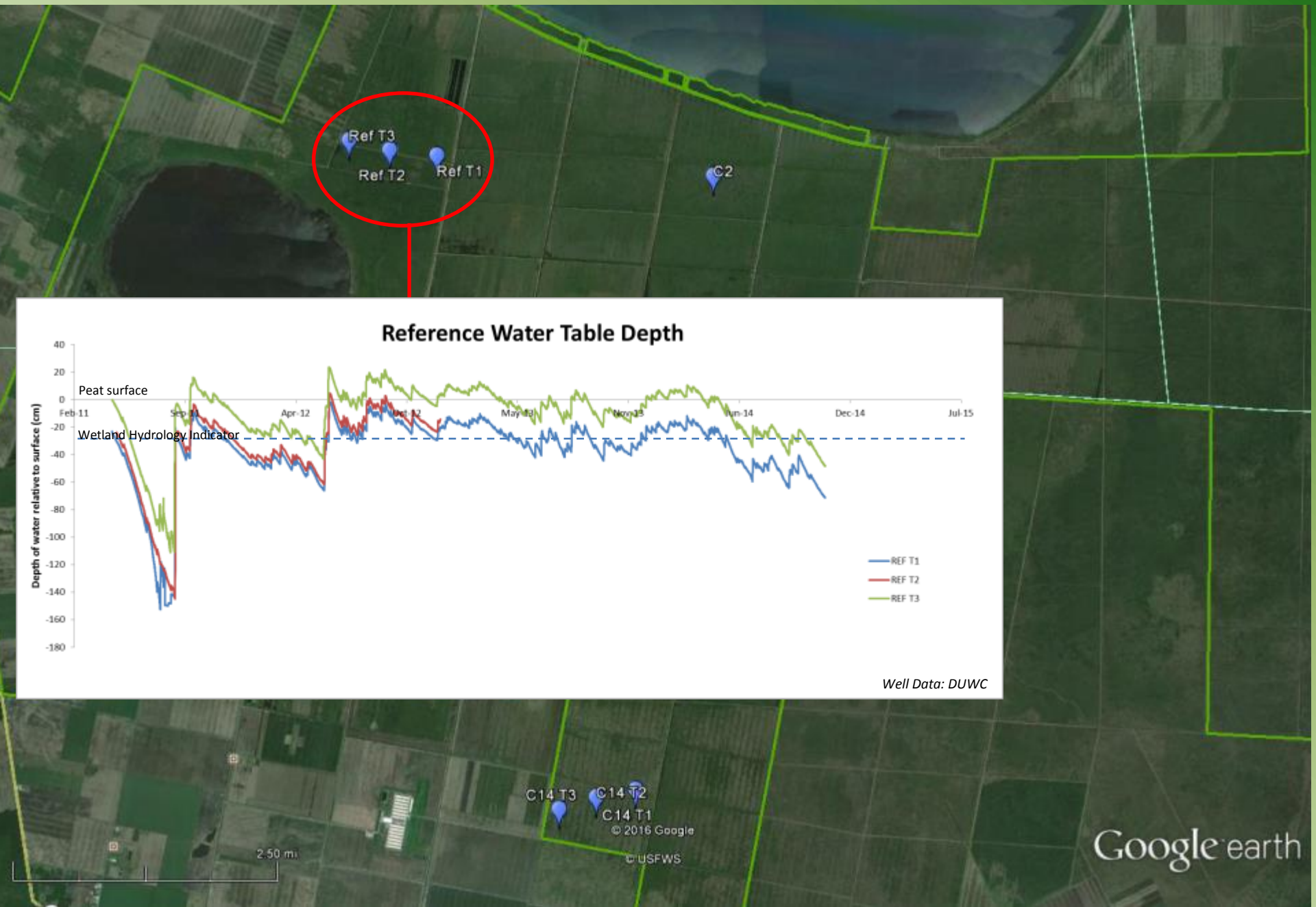
FWS is committed to saving the soil, protecting life and property, and meeting the wildlife conservation purpose of our refuges. Like farmers, we understand the value of soil conservation; rewetting organic, peat soils is the best way to prevent soil loss. Restoration also helps prevent catastrophic wildfires which threaten life, health, and property and attenuates some storm-related flooding.

Contact Us:
Pocosin Lakes NWR
Howard Phillips, Refuge Manager
howard_phillips@fws.gov
252-796-3004

Water Level: Restored (B7)

Water Level: Restored (C2)

Water Levels: Reference Site



Well Data: DUWC

Pocosin Lakes NWR 2016 Rainfall Data